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THE MANUFACTURE OF LOW-ACID RENNET-TYPE COTTAGE CHEESE[1]

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INTRODUCTION

Cottage cheese is a nutritious food product which, when properly made and cared for, is valued highly by the consuming public. It is essentially a skim milk curd into which cream is usually incorporated. The character and quality of the finished product, however, depend very largely on the methods of manufacture.

In general, the method of preparation consists of curdling the skim milk by adding a culture of lactic acid forming bacteria and/or rennet. As soon as the desired acidity has developed, the curd is cut or broken and then cooked or heated until it is of the desired firmness. The excess whey is then drained off and the curd is washed, cooled, salted, and blended with cream.

A popular type of cottage cheese is the mildly acid, large-grained product commonly known as low-acid rennet cottage cheese, or popcorn cheese, or sweet curd cottage cheese. These names are fairly descriptive because the curd is made into cheese before a pronounced acidity has developed and rennet is added to assist in curdling the skim milk

[1] This is a revision of a previous edition written by H. L. Wilson, dairy manufacturing specialist, who resigned November 16, 1942, and C. S. Trimble, dairy manufacturing specialist, who is now in charge of dairy products inspection.

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and to prevent the large cubes of curd from breaking into smaller particles. The curd particles are firm enough to retain their shape after cream has been added, but they are not hard or tough. In addition to its low-acid content and distinctive curd particles, this type of cheese is further characterized by its relatively good keeping qualities. Many manufacturers who are now making this type of cottage cheese

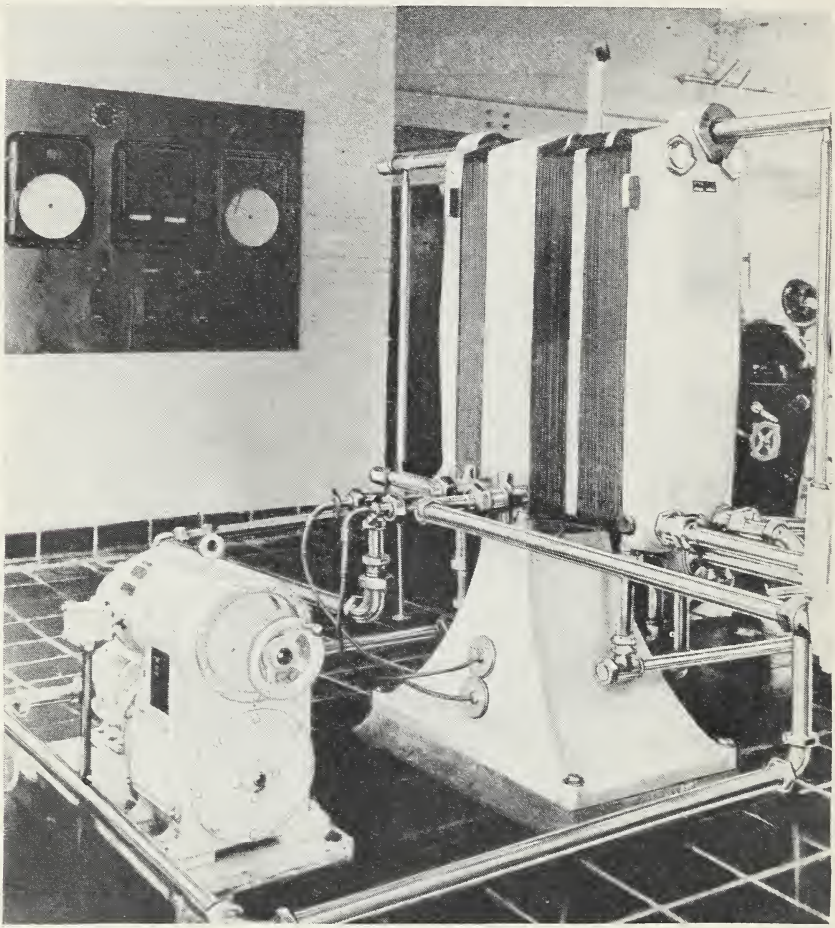


FIGURE 1.—A short-time, high-temperature pasteurizer.

have been able to build up a greater demand, and some have realized higher prices and greater profits, than when they made and marketed the older types of cottage cheese.

Low-acid rennet-type curd is firmer and drier than most other kinds of cottage cheese curd, and only 12 to 15 pounds of dry curd will be obtained from 100 pounds of skim milk. The cost of manufacture is about the same as for any other cottage cheese, however, and it is a superior product when properly made. Experimental work in the laboratories of the Bureau of Dairy Industry has resulted in the de-

velopment of procedures for making a uniformly high-grade product, and commercial manufacturers have used these procedures with consistent and excellent results. These procedures are described in the following pages.

FACTORS AFFECTING QUALITY OF COTTAGE CHEESE

The quality of the cheese depends largely on the quality of the skim milk from which it is made, and also on the quality of the milk or cream used for enriching the curd. Therefore it is important to use only milk or cream that is sweet, clean, and free from undesirable odors and flavors.

The skim milk should be pasteurized by heating it to 145° F. and holding it at that temperature for 30 minutes (holder method of pasteurization) or by heating it to 162° and holding at that temperature for 15 seconds (short-time, high-temperature method of pasteurization). (See fig. 1.) For best results the starter and rennet should be added immediately after the skim milk has been pasteurized and cooled. It is not a good practice to pasteurize the skim milk and hold it for several hours or overnight before starting the making process, as is sometimes done, but if it becomes necessary to hold the skim milk it should be cooled to 40° and held at that temperature until time to pasteurize it.

Cottage cheese is a perishable product, but if it is made properly and held at 32° to 40° F. it will keep satisfactorily for several days. The unenriched curd has much better keeping qualities than the enriched or creamed curd and may be stored for several months at these temperatures. In actual practice, however, it is desirable to make a fresh supply of curd frequently and to enrich only enough each day to meet the market demand. Immediately after cream has been incorporated into the relatively dry curd, the finished product should be cooled to between 32° and 40° and held at this temperature until it reaches the consumer. It is important from the standpoint of keeping quality and flavor to use only pasteurized cream or milk of the highest quality for enriching the curd.

EQUIPMENT REQUIRED

The first step in making a satisfactory product is to provide adequate equipment. The following equipment, with the exception of the whey tube and mechanical mixer, is required and may be obtained from dairy-supply companies:

Pasteurizer (short-time, high-temperature type preferred).
Cheese vat.
½-inch curd knives.
Whey tube.
Strainer scoops (two).
Acidity tester.
Curd pail (flat sided).
Dairy thermometer.
Wooden paddle.
Mechanical mixer.
Vat whey strainer.
1–cc. pipette.
10–cc. pipette graduated to 1 cc.
100–cc. volumetric flask graduated.
Straight-sided cans or butter tubs for holding the curd in storage.

An ordinary cheese vat equipped with a jacket should be provided. Water should be used in the jacket, since a slower and more uniform heat will be obtained in this way than when live steam is used.

Regular ½-inch horizontal and perpendicular Cheddar cheese curd knives are used to cut the curd into ½-inch cubes.

The whey-tube (fig. 2) is a very convenient piece of equipment to use in obtaining a representative sample of whey for the acidity test. A whey-tube may be constructed of ordinary tin or copper. It is a tube 4 inches in diameter and 6 inches long, with a 1½-inch collar or flange 1½ inches from the top. In the winter when the temperature of the room drops during the night, the whey below the surface of the curd may have a higher temperature and will therefore show a higher acidity than the whey above the surface. The whey-tube is set on the curd, and when it sinks down to the flange the curd is dipped out of the tube with a spoon (bend the handle of the spoon to a right angle with the bowl). Within a few minutes whey from beneath the

FIGURE 2.—Whey tube used in obtaining a sample of whey.

surface of the curd will rise in the tube, and a representative sample may be obtained for the acidity test.

Another convenient method for obtaining a representative sample of whey is to remove the surface curd, take a sample of the curd from 2 or 3 inches below the surface, place it in a small piece of muslin, and squeeze the whey from the curd into a glass.

The mechanical mixer (sometimes called a cake or dough mixer) is used when enriching and mixing the curd (fig. 3).

The cans for storing the curd should be of the straight-sided type, from which the curd is easily removed. A can of this type is shown in figure 3. Many plants use the ordinary wide-mouthed 10-gallon milk cans.

The strainer scoops are the ordinary curd scoops with strainer bot-

toms. They are useful in picking up the curd when the whey is being drained from it.

A flat-sided curd pail is more convenient for dipping the curd from the vat than an ordinary round pail.

The wooden paddle should be a large long-handled one, for use in the first stages of stirring the curd.

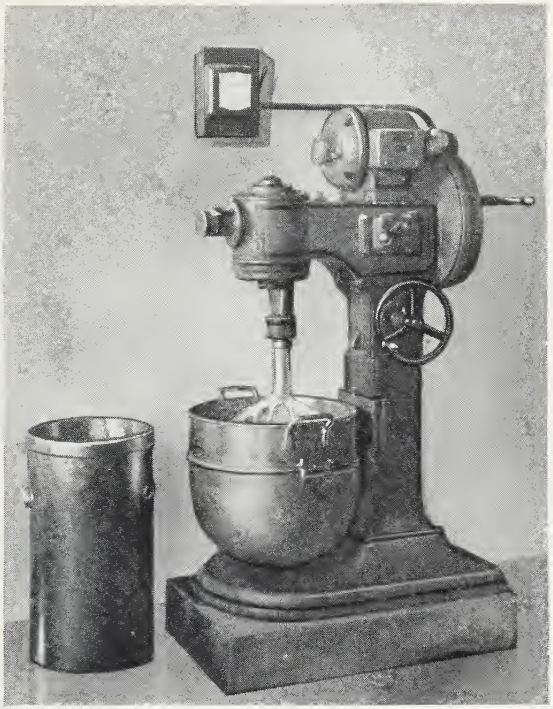


FIGURE 3.—A mechanical mixer and a straight-sided can.

SETTING THE SKIM MILK

To obtain the best flavored cheese the skim milk should be set at a temperature of 70° to 72° F., and enough active lactic starter should be added to produce the desired coagulation and an acidity of from 0.51 to 0.53 percent in the whey at the time the curd is to be cut. In addition to the starter, approximately 1 cc. of rennet and ¾ cc. of cheese color should be added to each 1,000 pounds of skim milk. The skim milk should be held at the setting temperature throughout the incubation period of several hours, and the top of the vat should be kept covered so the top portion of the milk will not cool.

The character of the curd will vary with the amount of starter used, and the longer the incubation period the smaller will be the amount of starter required. For an incubation period of 8 to 10 hours from setting time to cutting time, the amount of starter should be from 0.5 to 1 percent; for an incubation period of 4 to 6 hours, the amount of starter should be from 6 to 10 percent. The shorter incubation period may be more convenient in some instances, but the longer incubation

period with the smaller amount of starter will produce the best flavored cheese.

Since the starter has a great influence on the quality of the finished cheese, too much emphasis cannot be placed on the importance of using a good, active lactic starter that has a pleasing aroma. A poor starter used for one batch may easily cause the loss of a market that has required weeks to develop. An active starter with a range of 0.70 to 0.85 percent of acidity should be used. The very best skim milk should be used in preparing the starter, and it should be grown under rigidly controlled temperature conditions.

Before the rennet is added to the skim milk it should always be diluted at the rate of 1 part of rennet to 20 parts of cold water. In processing 1,000 pounds of skim milk the amount of the diluted solution to add is determined easily. If less than 1,000 pounds is to be processed, the amount of the diluted rennet to add may be determined by proper use of the pipette and volumetric flask or graduate. For example, at the rate of 1 cc. of rennet to 1,000 pounds of skim milk, 550 pounds of skim milk would require 0.55 cc. of undiluted rennet. To obtain this amount measure 1 cc. of undiluted rennet, by means of the pipette, into the 100-cc. volumetric flask and fill the flask with cold water to the 100-cc. mark. Then for each 0.01 cc. of rennet required, measure out 1 cc. of the diluted solution and add to the skim milk. The 550 pounds of skim milk would require 55 cc. of the diluted solution. Stir the milk well after the rennet has been added.

CUTTING THE CURD

When the curd is firm but not hard or brittle it is ready to be cut. Perhaps the best guide to the proper cutting time is the acidity of the whey. The curd should not be cut before the whey has reached an acidity of 0.51 percent, but it should be cut before the acidity is more than 0.53 percent. Curd cut when the acidity of the whey is less than 0.51 percent is likely to become tough when it is cooked, and if it is cut when the acidity is more than 0.53 percent it tends to break up during cooking.

The curd should first be cut lengthwise of the vat with the horizontal knife, then both crosswise and lengthwise with the vertical knife. This cuts the curd into cubes of uniform size. If larger cubes than can be cut with the ½-inch knives are desired, ¾-inch knives may be used. While the curd is being cut, the jacket of the vat should be kept filled with tepid or cold water.

COOKING THE CURD

Great care should be exercised in cooking the curd. The cooking should be done slowly. From 1 to 2 hours should be taken to raise the temperature from that at cutting time to the final cooking temperature. The final cooking temperature may be between 110° and 120° F., depending on the character of the curd and the acidity of the whey.

As soon as the curd has been cut, the steam valve may be opened to allow steam to flow into the water in the jacket of the vat. At the same time warm water (115° to 120° F.) may be run over the top of the curd to a depth of 2 inches or more. This will tend to firm

the top in case it has become colder than the curd deeper in the vat. If space in the vat permits, warm water may be added until the contents of the vat have been raised to 100°, but it is much better to apply the additional heat needed by allowing steam to flow into the jacket of the vat. The temperature of the curd will rise slowly, and the curd will firm up considerably if the water in the jacket is kept 25° to 35° warmer than the curd; but the water should never be more than 35° warmer than the contents of the vat.

While the temperature of the curd is being raised slowly, the curd should be stirred just enough to insure an even cooking but the stirring should be done gently (fig. 4). Stirring should not be started, however,

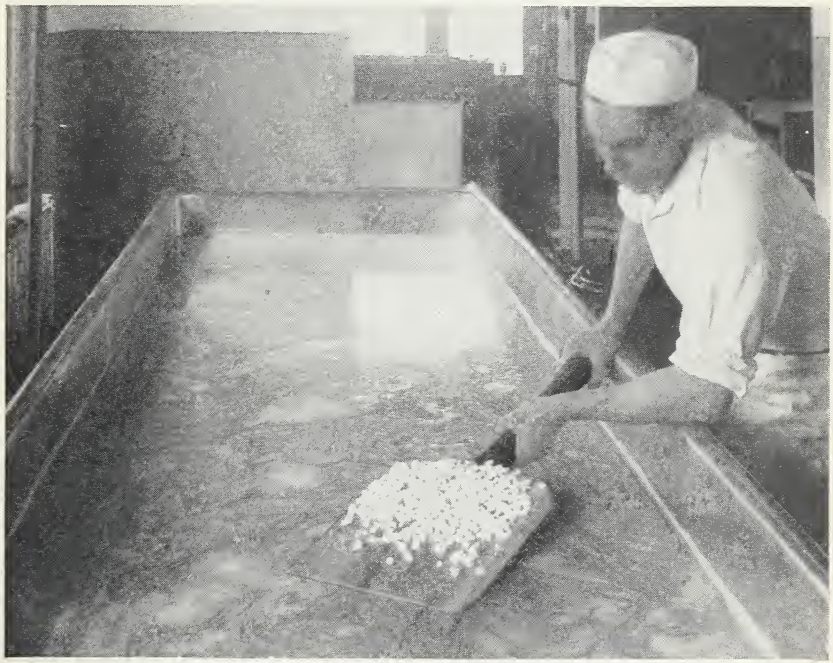


FIGURE 4.—Stirring the curd while cooking.

until it can be done without breaking the curd and causing the whey to become cloudy; otherwise the cheese will not have the characteristic large-grained appearance of this particular type. A hard brittle curd should not be stirred until after the temperature has been raised to 100° F.

Usually a final cooking temperature of 110° to 120° F. will be sufficiently high to firm the curd, especially if the curd is jelly-like and the whey has an acidity of 0.51 to 0.53 percent when the curd is cut. If the curd is too hard and brittle, however, and the acidity of the whey is too high, it will be difficult to get a firm, relatively dry curd, even by cooking it at an abnormally high temperature. If the curd is soft and the whey has an acidity lower than 0.51 percent, the cheese is apt to be tough and undesirable, regardless of how low a cooking temperature is used.

The quantity of skim milk in the vat is also a factor to consider in determining the final cooking temperature, because it takes longer to remove the whey and cool the curd from a large quantity than from a smaller quantity. Therefore, a relatively low cooking temperature can be used when large quantities of skim milk are being processed.

The curd is sufficiently cooked when it will retain its shape under light pressure between the hands; or, when a handful of the curd placed in a dipper of cold water feels firm and the curd particles retain their shape. The whey may then be drained off and the curd washed.

WASHING AND DRAINING THE CURD

When the curd has reached the desired firmness, allow it to settle to the bottom of the vat and then carefully push it back from the vat gate about one-third the length of the vat. The gate can then be opened wide, permitting the whey to drain off in the shortest possible time. If the curd is of the proper firmness it will remain about where it was pushed; but as soon as the curd begins to show well above the surface of the whey the gate should be closed partly so that particles of curd will not flow down against the strainer. Small ditches should be made in the curd along the sides of the vat to aid in draining the whey off more completely.

After all the whey has been drained off, close the gate and fill the vat with tap water up to the original level of the milk. Care should be taken in adding the water so that the curd will not be broken. After the water has been added, stir the curd and allow it to settle, push it back again, and then drain off the wash water. When the curd begins to show, make a ditch or trench down the center to facilitate drainage of the water.

Two washings are usually sufficient, but the second washing should be done with ice water if possible and enough water should be used to cover the curd. After the curd is washed, drain off the water as before, and then allow the curd to remain in the vat for about an hour so it will drain thoroughly.

SALTING AND CHILLING THE CURD

After the curd has drained thoroughly it may be salted lightly. Spread the curd out in the vat and add 1 pound of salt for each 1,000 pounds of skim milk used. Mix the salt thoroughly with the curd, taking care not to break the curd.

The salted curd may then be put into butter tubs, straight-sided cans, or on regular drain racks, and placed in cold rooms (32° to 40° F.), where it should be held for several hours before it is enriched or prepared for market. When the curd has been properly chilled it will be in satisfactory condition for enriching, and the cream or milk can be added without causing excessive breakage. The general appearance of the curd after chilling is shown in figure 5. Figure 6 shows an acid, nonrennet type of curd.

ENRICHING AND MIXING THE CURD

The character of this type of curd is such that it will absorb relatively large amounts of cream or milk, yet because the curd is firm the particles will retain their shape after mixing. Different lots of

FIGURE 5.—The low-acid rennet-type curd, after chilling (actual size).

FIGURE 6.—Acid nonrennet type of curd (actual size).

curd, however, may vary greatly in their ability to absorb cream and milk. Some lots will appear moist after enrichment while others may seem dry. To put out a cottage cheese with uniform moisture and fat content, the curd should first be standardized to the desired fat content by adding pasteurized cream that has a fat content of 18 percent; and then, if the cheese is not moist enough, sufficient pasteurized whole milk of the same fat content as the standardized curd should be added to get the desired amount of moisture.

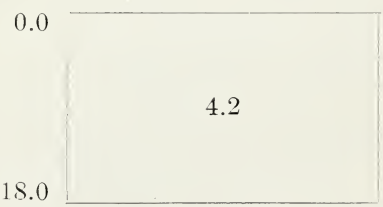
The fat content desired in the finished cheese will vary with market conditions and other requirements. For interstate shipment, the fat content of creamed cheese must be at least 4.0 percent by weight. The higher the fat content, of course, the less profit there will be unless the cheese is sold for a price that will compensate for the cost of the extra fat. Uniformity of fat content from day to day is probably more important from a marketing standpoint than an exceptionally high fat content.

Enriching the curd, of course, makes the product more palatable and also more nutritious. In most cases enriched cottage cheese sells more readily than the plain cheese. Since 1 pound of cream testing 18-percent butterfat, when added to the curd, will increase the amount of cottage cheese by 1 pound, the profitableness of adding the cream can be calculated easily. For example, when a pound of enriched cottage cheese sells for 26½ cents, the pound of added cream will also sell for 26½ cents, or at the rate of $1.47 per pound of butterfat.

The amount of cream required for standardizing the fat content of cottage cheese may be calculated by the "square" method. While the curd may contain a small amount of fat it can be disregarded in the standardizing procedure since it will serve as a factor of safety in meeting Federal and State standards.

Suppose the problem is to determine how much cream containing 18 percent of fat will be required to enrich 100 pounds of curd, in order to obtain a cottage cheese containing 4.2 percent of fat. Determination by the "square" method would be as follows:

Figures representing the fat test of the curd (0 percent) and the fat test of the cream (18 percent) are placed at the left-hand corners of a square, and the desired test of the cheese is indicated in the center of the square.



Going diagonally across the square and subtracting the smaller figure from the larger one in each case gives 13.8 parts of curd for 4.2 parts of cream. Setting these figures down as a proportion gives the following equation: 13.8:4.2 :: 100:X. Working this equation, X = 30.4. Therefore, it will take 30.4 pounds of 18-percent cream for each 100 pounds of curd to produce 130.4 pounds of cottage cheese

containing 4.2-percent fat. If the curd does not appear to have enough moisture, enough 4.2-percent milk can be added to give the desired moisture content without affecting the fat content of the finished cheese.

Before either cream or milk is used for enriching the curd, it should be pasteurized. It is also advisable to homogenize the cream and milk immediately after pasteurization, at a pressure of 2,500 pounds to the square inch. The pasteurized and homogenized milk or cream should be cooled before it is added to the curd.

When large quantities of curd are to be enriched it is necessary to use some type of mechanical mixer, preferably one equipped with a flat-type beater. Unless the mixing is done vigorously, the mixture will not become thick and viscous. Large amounts of curd can be mixed more quickly with a mechanical mixer than by hand, and the combined beating and stirring action of the mechanical mixer plays an important part in producing the characteristic body and texture desired in this type of cheese.

Small batches of curd and cream may be mixed by hand, but hand mixing requires vigorous stirring for a longer period than mechanical mixing, in order to produce the same characteristics in the enriched cheese.

An ordinary 80-quart cake mixer (fig. 3) is satisfactory for mixing 100 pounds of curd and 30.5 pounds of 18-percent cream. Add 1 pound of salt per 100 pounds of curd, and run the mixer for 2 or 3 minutes. This will produce a cheese with a uniform fat content of 4.2 percent. Then if the cheese appears to be too dry, enough whole milk (testing 4.2 percent fat) may be added to produce the desired consistency without affecting the fat content. Continue to run the mixer in low gear for about 5 minutes, then the enriched cheese may be packaged and set in the cooler to become firm. After the cheese has been held in storage for a few hours, the curd will have absorbed some of the excess moisture and it will then have the creamy appearance which is characteristic of this type of cottage cheese.

STORING COTTAGE-CHEESE CURD

Cottage-cheese curd is always best when fresh. In case of a surplus of curd, however, it may be held for several months and yet be satisfactory for market purposes. Stored in 4-percent brine, the unenriched curd will keep from 60 to 90 days if held at temperatures ranging between 30° and 40° F.[2] Freezing injures the body of this type of curd. The freezing point of a curd with 78.7 percent of moisture is 29.84°.

In preparing the stored curd for market, only enough should be enriched each day to supply the immediate demand.

MARKETING

When low-acid rennet-type cheese is made properly and enriched, it has a rich, creamy appearance and a distinctive texture, which make it attractive to consumers.

[2] The manufacture of cultured buttermilk and cottage cheese. E. L. Fouts and L. E. Mull. Fla. Agr. Exp. Sta. Bul. 382, 18 pp. illus. 1943.

The manufacturer may deliver his product to the retailer in lots of 50 to 100 pounds in bulk containers, or he may package it in 12- to 16-ounce containers ready for sale to the consumer (fig. 7). If the manufacturer puts the cheese in the small containers, it should be done as soon as the cheese has been enriched and before it "sets up."

When the retailer handles the bulk cheese, its distinctive characteristics can be displayed to consumers to advantage by using an open jar or tray display in a refrigerator case.

As a further means of building up sales, the manufacturer may supply the dealer or retailer with the small containers in which to package the cheese for consumers. To prevent misuse of the empty

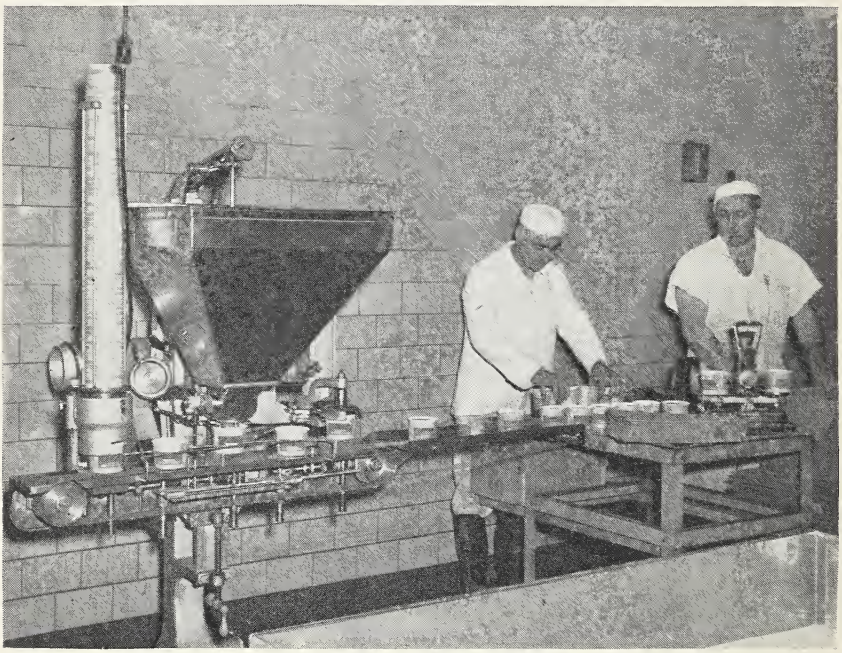


FIGURE 7.—Packaging cottage cheese with an automatic filling machine.

containers, a definite number should accompany each delivery of 50 or 100 pounds of the bulk cheese. The containers may have both the manufacturer's name and the dealer's name on them, also an attractive and descriptive label.

In many instances, manufacturers have established regular routes and customers, both wholesale and retail. To make sure that the consumer will always receive cheese of the highest quality, it is important that the manufacturer supply the dealer with fresh cheese at regular intervals. A high-grade product, put up in an attractive package and under a distinctive name, and delivered promptly and frequently, plays an important part in the successful marketing of this type of cheese.

BRIEF DIRECTIONS FOR MAKING COTTAGE CHEESE

Pasteurize the skim milk—by heating at 145° F. for 30 minutes if the holding method is used, or by heating at 162° for 15 seconds if the high-temperature, short-time method is used.

Set the skim milk at 70° to 72° F. and add enough active lactic starter (0.5 to 1 percent for an 8- to 10-hour setting period) to produce from 0.51 to 0.53 percent of acidity in the whey by the time the curd is to be cut. (The curd should be firm but not hard and brittle at cutting time.)

Always use a good starter, and in addition to the starter, add 1 cc. of rennet per 1,000 pounds of skim milk.

Maintain the setting temperature throughout the fermentation period.

Cut the curd into ½-inch cubes or larger if desired.

Run 2 or more inches of warm water (115° to 120° F.) over the cut curd, and start to apply steam to the water in the jacket of the vat at once. Bring the temperature of the curd up to 100° F. slowly.

Stir the curd carefully until it will stand stirring without breaking.

Keep the water in the vat jacket from 25° to 35° F. warmer than the curd.

Cook the curd slowly to a temperature of 110° to 120° F., in 1 to 2 hours, or until proper firmness is obtained.

When the curd will retain its shape under light pressure between the hands, draw off the whey.

Wash the curd first with tap water and then with ice water.

After the curd has been washed, ditch it, allow it to drain for 1 hour, then put it on trays, or in cans or tubs, and place it in a cooler at 32° to 40° F. for at least 4 hours. At the end of this period the curd will be firm and dry.

To each 100 pounds of the curd, add 1 pound of salt, 30½ pounds of cream testing 18-percent fat, and enough whole milk testing 4.2 percent fat to produce the desired consistency. This will give a finished product containing 4.2 percent of butterfat. The cream and milk should be of the highest quality and should be properly pasteurized and homogenized before being added to the curd.

Stir the mixture of curd, cream, and milk vigorously by hand, or if a mechanical mixer is used run it in low gear for about 5 minutes. If packaging is done with a filling machine, it should be done at once. Place the packaged cheese in cold storage until it is delivered to the consumer.

The curd should be firm, and even after it is mixed the curd particles should be distinct; however, the curd should not be tough or hard. Careful cooking is required to get the proper degree of firmness.

FEDERAL DEFINITIONS AND STANDARDS FOR COTTAGE CHEESE

After a series of hearings, the following Federal definitions and standards for cottage cheese became effective in 1943:

Cottage cheese, identity.—(*a*) Cottage cheese is the soft uncured cheese prepared by the procedure set forth in paragraph (*b*) of this section. The finished cottage cheese contains not more than 80 percent of moisture. . . .

(*b*) (1) Sweet skim milk is pasteurized; calcium chloride may be added in a quantity not more than 0.02 percent (calculated as anhydrous calcium chloride)

of the weight of such skim milk; harmless lactic-acid-producing bacteria, with or without rennet, are added and it is held until it becomes coagulated. The coagulated mass may be cut; it may be warmed; it may be stirred; it is then drained. The curd may be washed with water and further drained; it may be pressed, chilled, worked, seasoned with salt.

(2) For the purposes of this section skim milk means the milk of cows from which the milk fat has been separated.

Creamed cottage cheese, identity.—(*a*) Creamed cottage cheese is the soft uncured cheese prepared by mixing cottage cheese with pasteurized cream or a pasteurized mixture of cream with milk or skim milk or both. Such cream or mixture is used in such quantity that the milk fat added thereby is not less than 4 percent by weight of the finished creamed cottage cheese. The finished creamed cottage cheese contains not more than 80 percent of moisture. . . .

(*b*) For the purposes of this section milk means sweet milk of cows and skim milk means milk from which the milk fat has been separated.

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